LAD
Cable and Trigger Diagrams
v0.2

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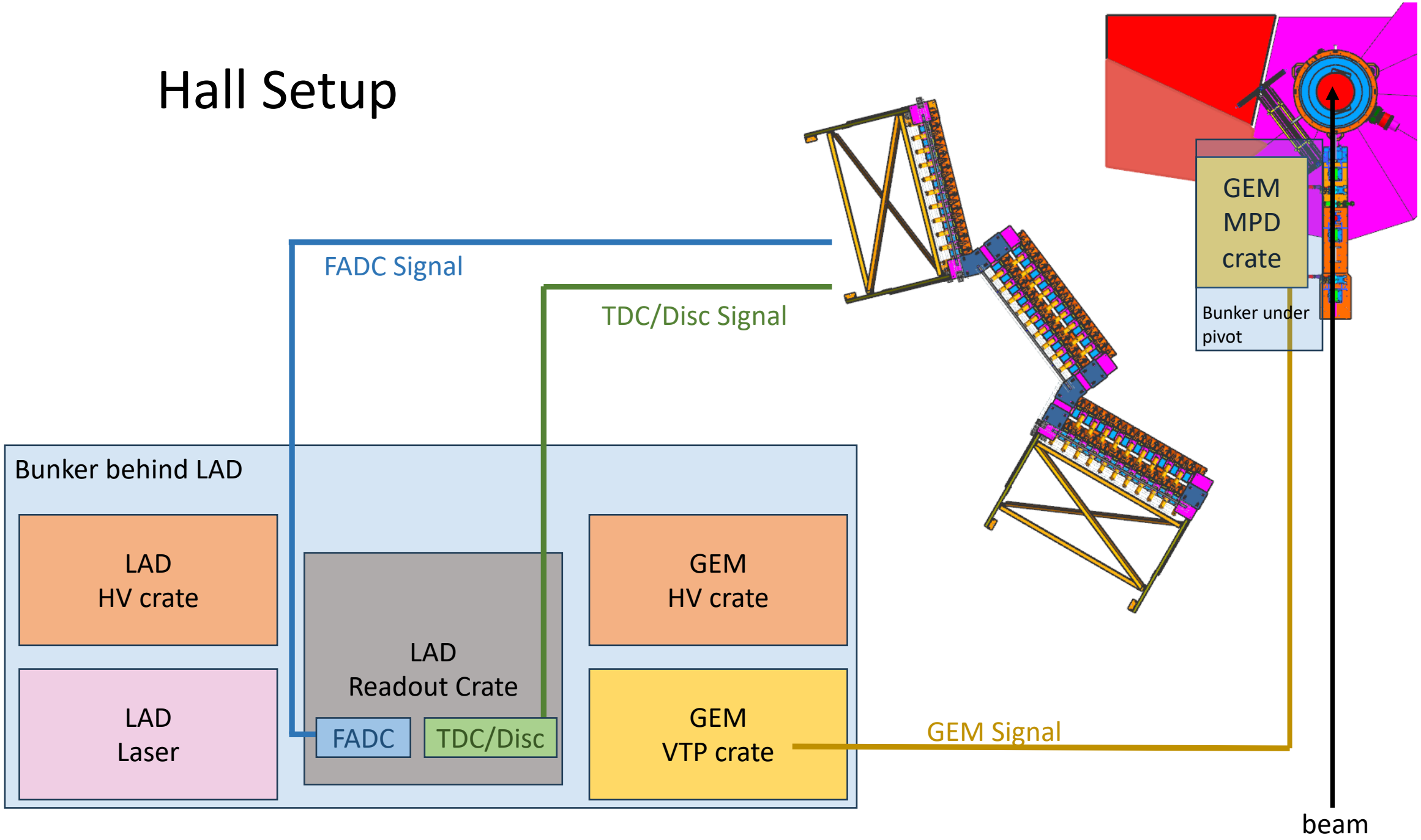
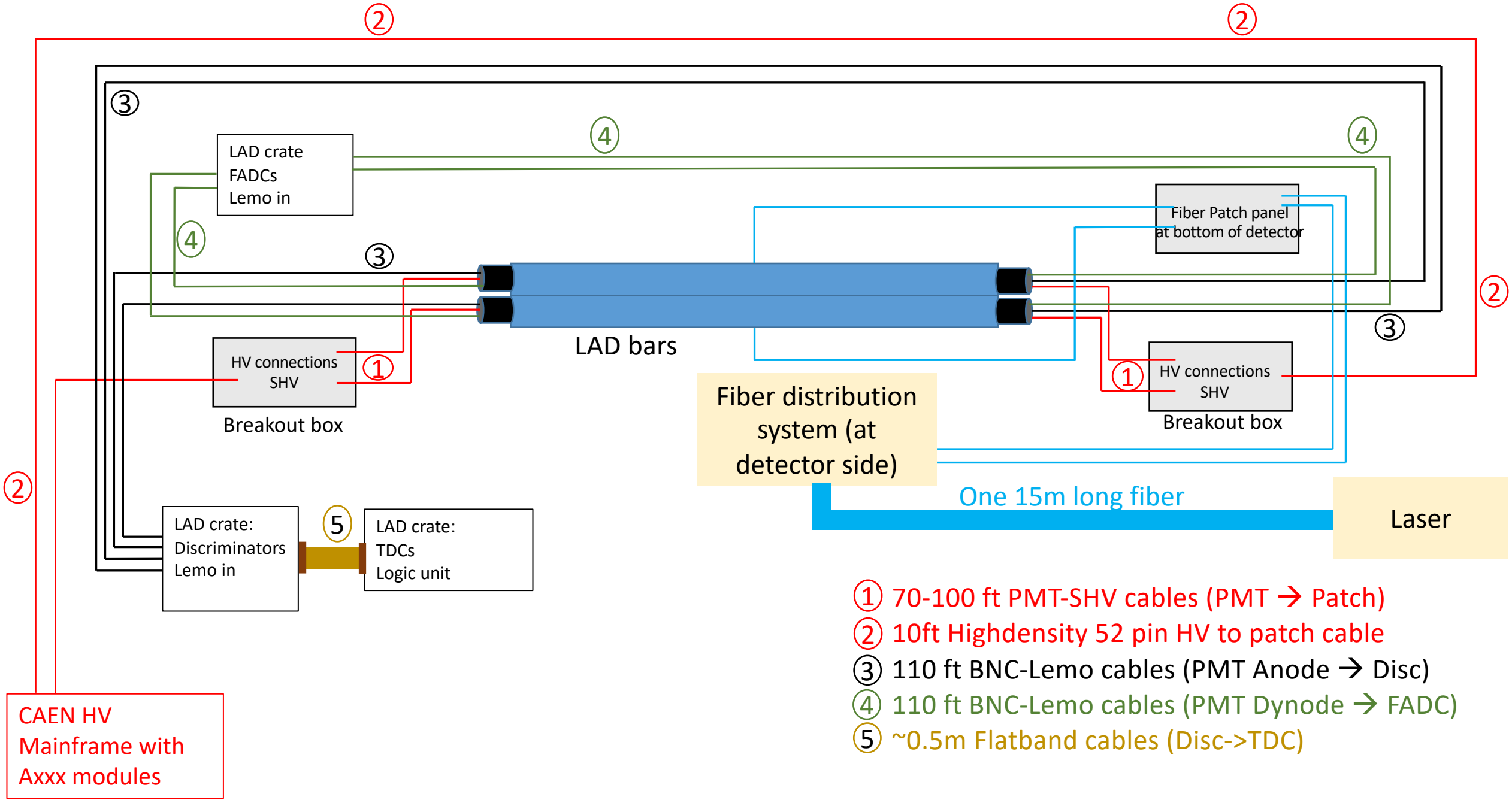
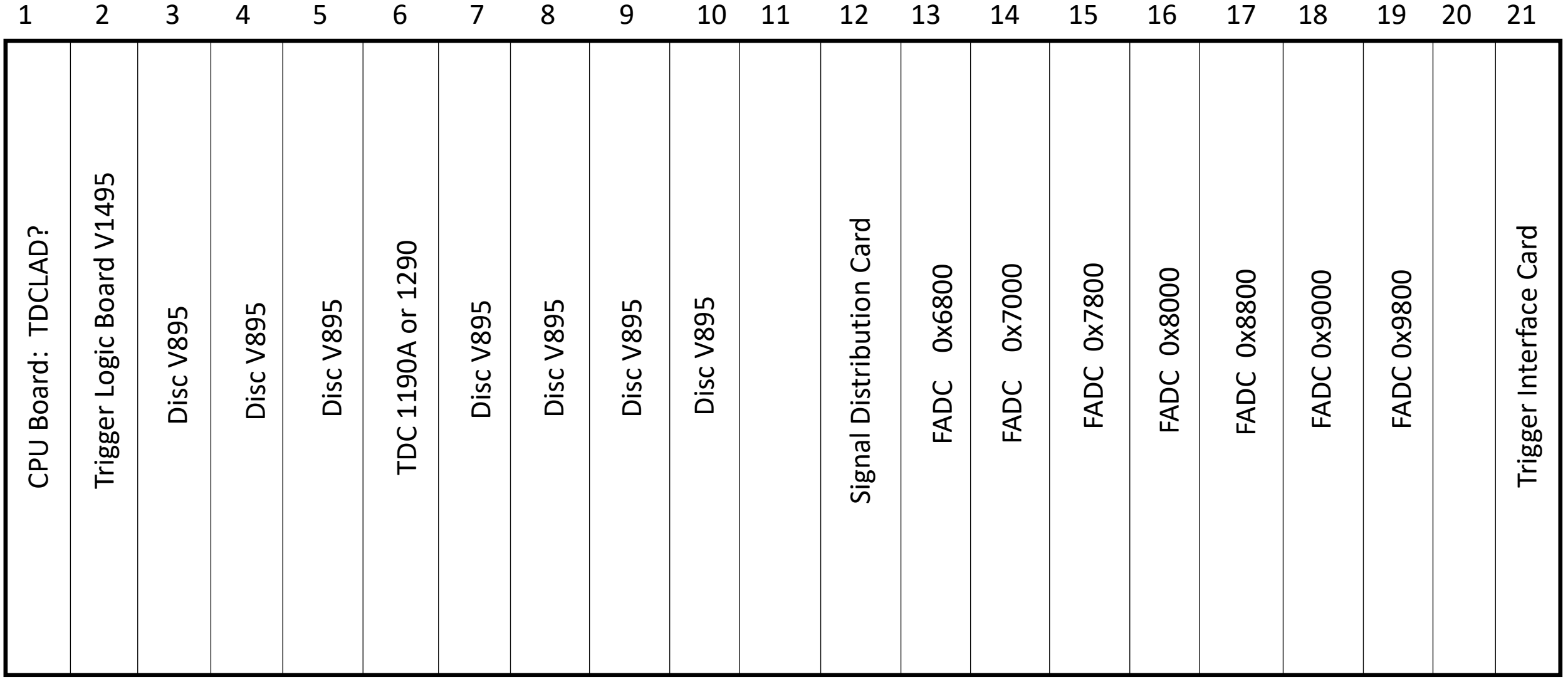
10/09/2024

Hall Setup


FADC Signal
TDC/Disc Signal
GEM
MPD
crate
Bunker under
pivot
Bunker behind LAD
LAD
HV crate
LAD
Readout Crate
FADC
TDC/Disc
GEM
HV crate
LAD
Laser
GEM
VTP crate
GEM Signal
beam


②
②
③
LAD crate
FADCs
Lemo in
④
④
④
③
Fiber Patch panel
at bottom of detector
②
③
HV connections
SHV
①
LAD bars
①
HV connections
SHV
Breakout box
Breakout box
Fiber distribution
system (at
detector side)
One 15m long fiber
Laser
②
LAD crate:
Discriminators
Lemo in
⑤
LAD crate:
TDCs
Logic unit
CAEN HV
Mainframe with
Axxx modules
① 70-100 ft PMT-SHV cables (PMT → Patch)
② 10ft Highdensity 52 pin HV to patch cable
③ 110 ft BNC-Lemo cables (PMT Anode → Disc)
④ 110 ft BNC-Lemo cables (PMT Dynode → FADC)
⑤ ~0.5m Flatband cables (Disc->TDC)

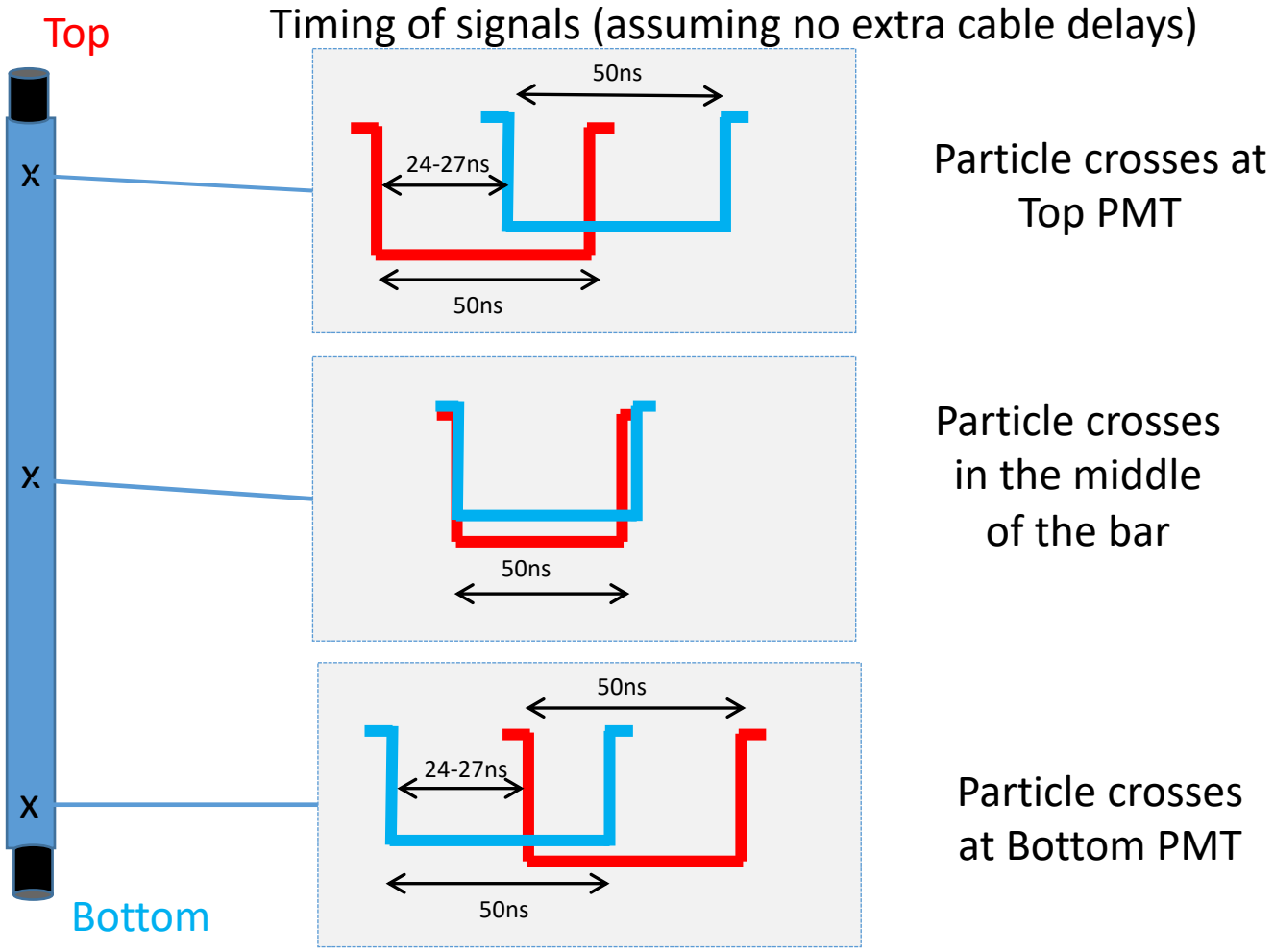
LAD Readout Crate: Crate Number xx



1V Jumper all FADCs probably (maybe 0.5V)

Bar Coincidence Timing

- Length of bars between 387.5cm and 445.1cm in each panel
- Assuming effective velocity of 16.5 cm/ns → 24ns to 27ns difference between signals at PMTs

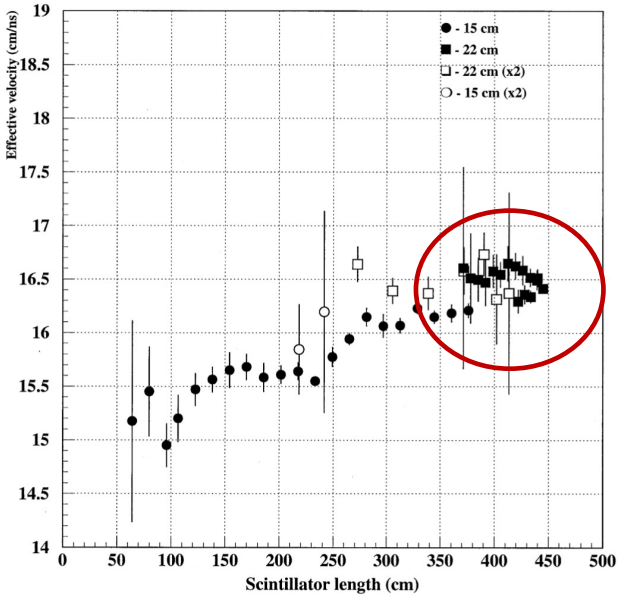


Particle crosses at Top PMT

Particle crosses in the middle of the bar

Particle crosses at Bottom PMT

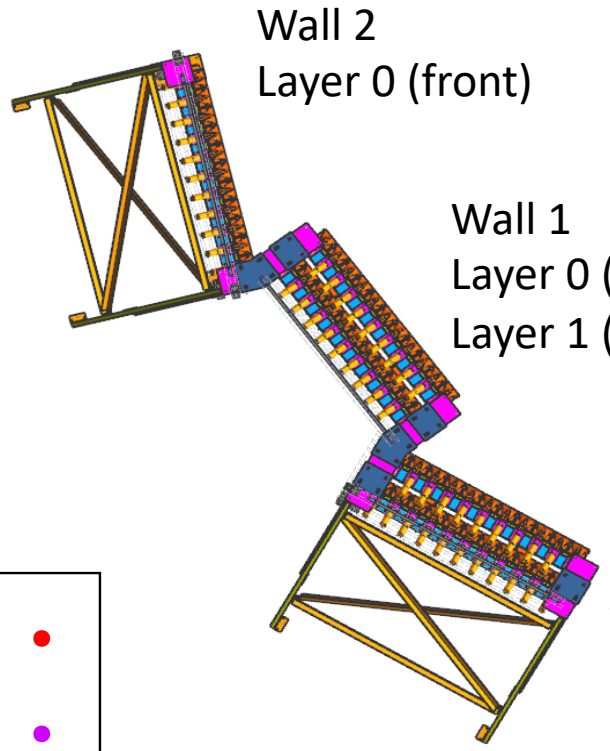
E.S. Smith, NIM A432, 265 (1999)



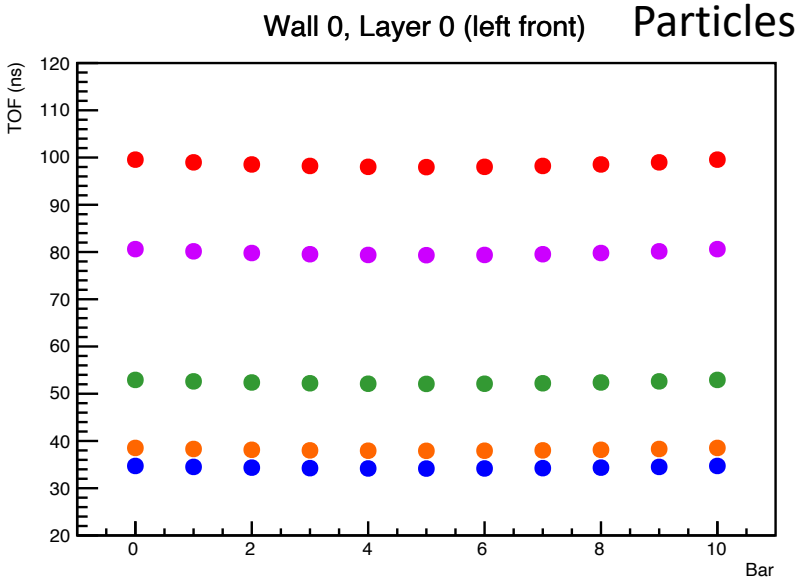
- Conclusion: Bar coincidence signal within a 30ns window

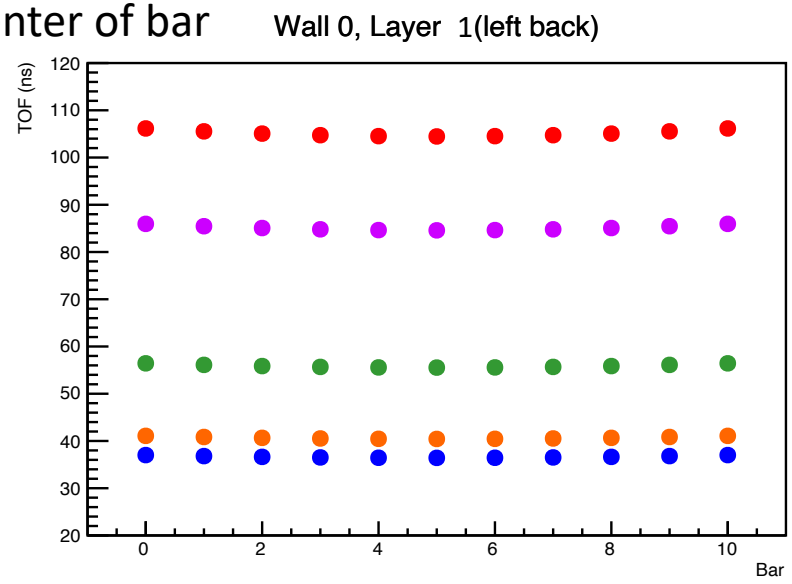
Time of Flight for Particles from Target (1)

- Wall 2 Layer 0 is symmetric to Wall 0 Layer 0 → same ToF from target
- Assume protons from 200MeV/c to 700 MeV/c to be conservative (Note: We expect a higher mimimum momentum)



Particles at center of bar

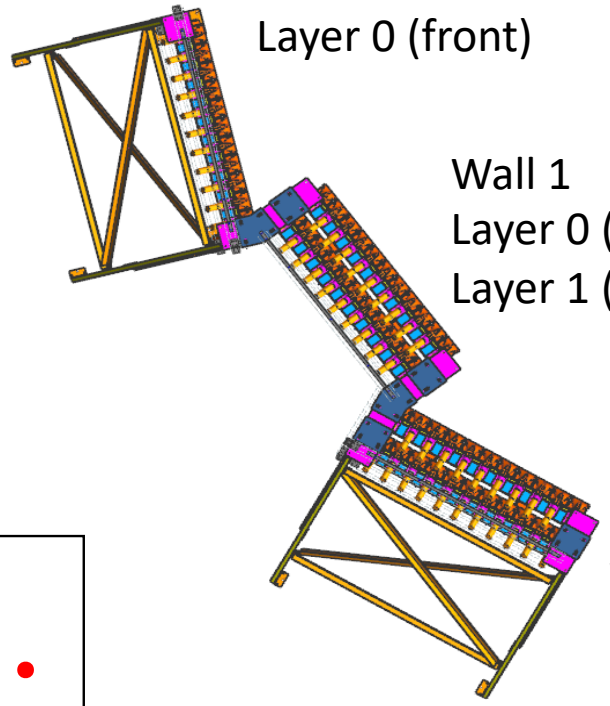




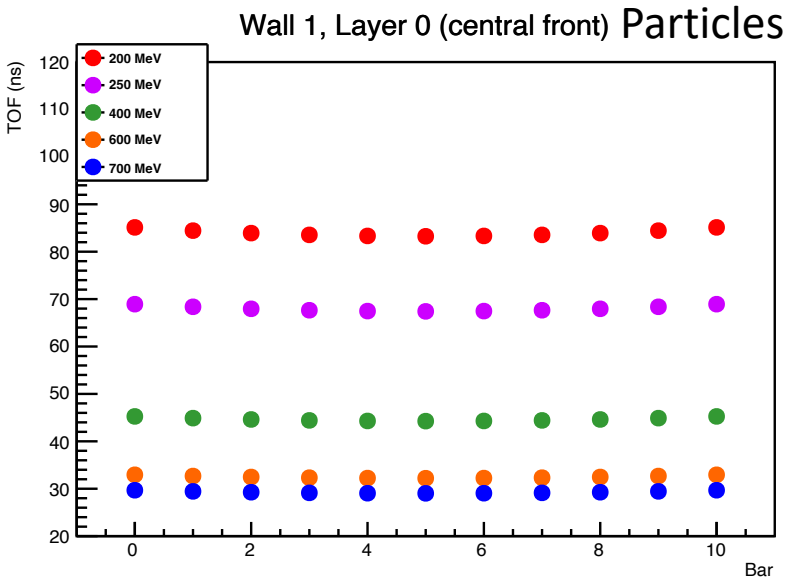
- ToF range from 30ns to 110ns

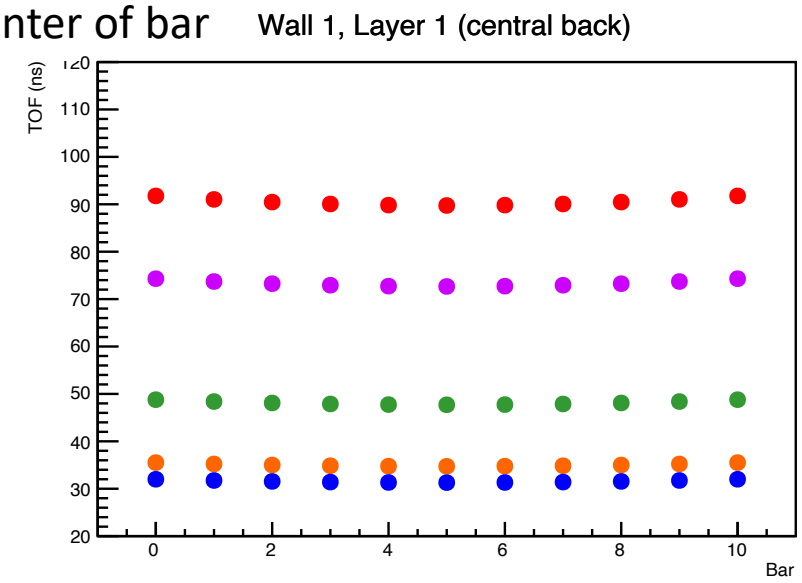
Time of Flight for Particles from Target (2)

- Wall 2 Layer 0 is symmetric to Wall 0 Layer 0 → same ToF from target
- Assume protons from 200MeV/c to 700 MeV/c to be conservative (Note: We expect a higher mimimum momentum)



Particles at center of bar

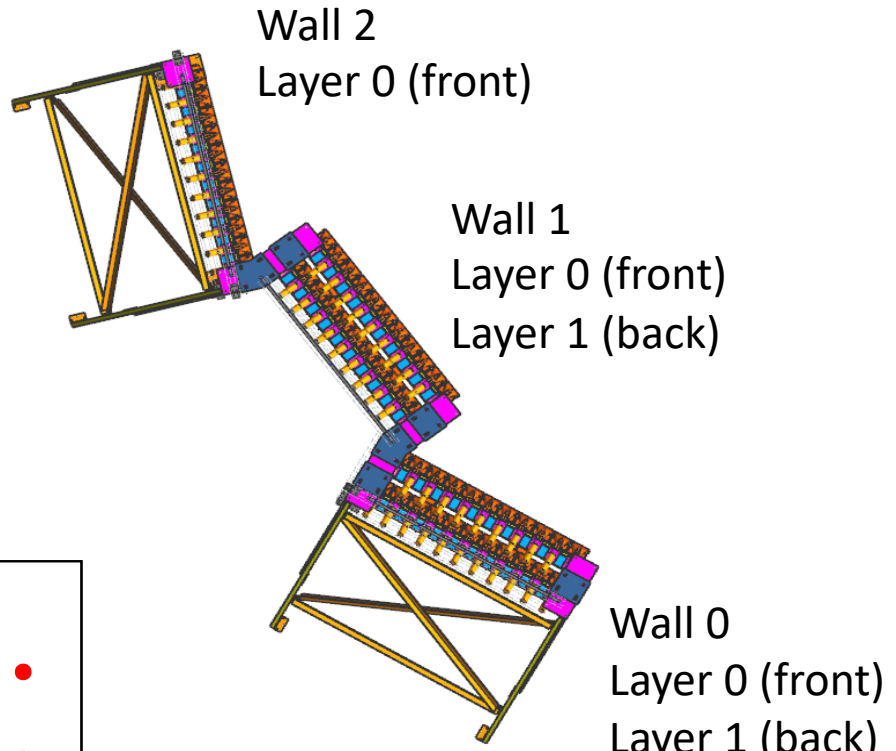




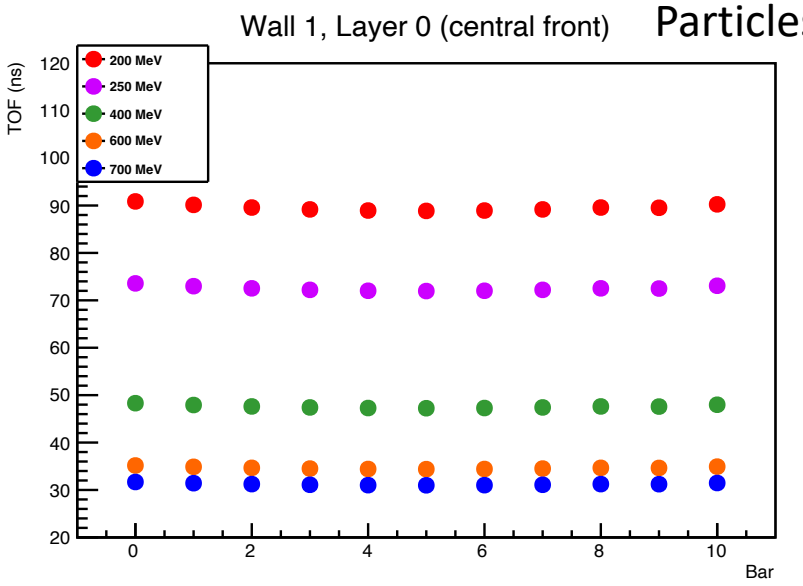
- ToF range from 26ns to 95ns

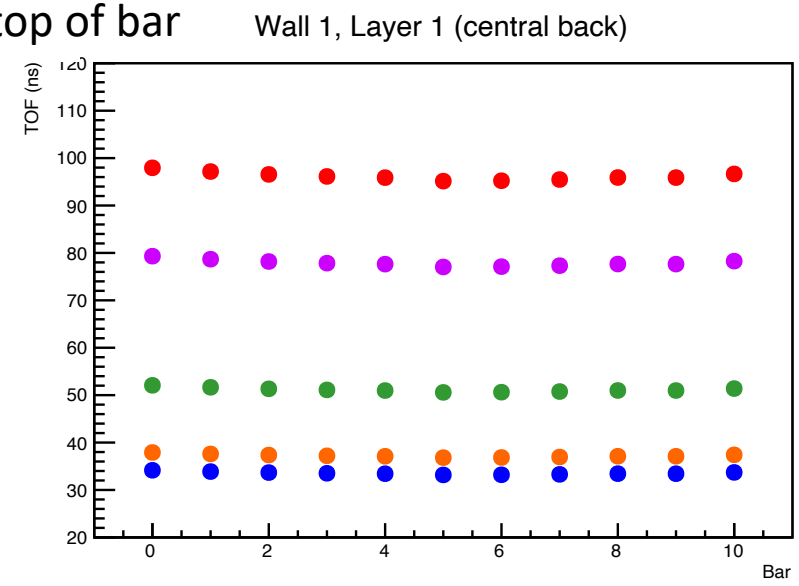
Time of Flight for Particles from Target (3)

- Wall 2 Layer 0 is symmetric to Wall 0 Layer 0 → same ToF from target
- Assume protons from 200MeV/c to 700 MeV/c to be conservative (Note: We expect a higher mimimum momentum)



Particles at top of bar

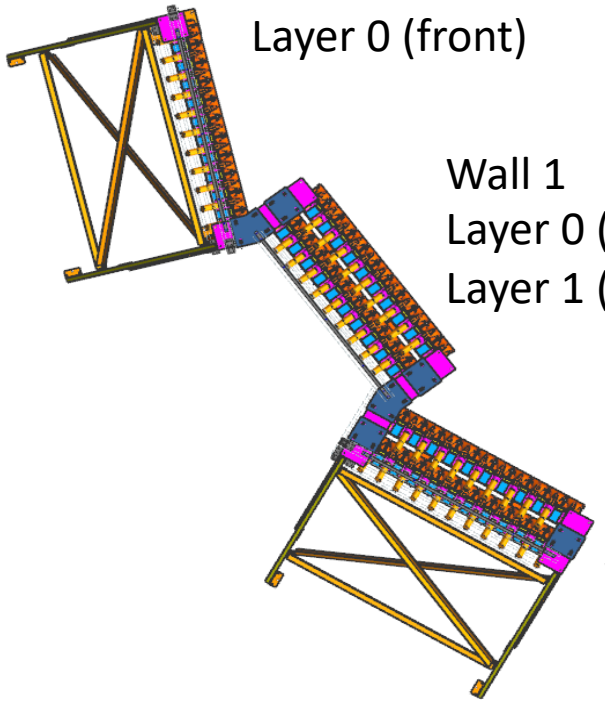




- ToF between 30ns to 100ns
- Not much effect from where it hits (~5ns) since pathlength dominated by distance from target

Time of Flight for Particles from Target (4)

- Wall 2 Layer 0 is symmetric to Wall 0 Layer 0 → same ToF from target
- Assume protons from 200MeV/c to 700 MeV/c to be conservative (Note: We expect a higher mimimum momentum)
- Minimum ToF of all bars: 25ns
- Maximum ToF of all bars: 115ns



- Conclusion: Have conservative 100ns window from ToF (20 to 120ns)
- Together with bar coincidence variation -> 130ns

- Might need to check also pion window

Trigger Setup for coincidence and singe arm triggers

SHMS Single Arm Trigger

HMS Single Arm Trigger

SHMS EReal

HMS EReal

OR Logic

TS

This is in the CH

Delay?

LAD Disc Output

V1495 Logic Unit

In the hall

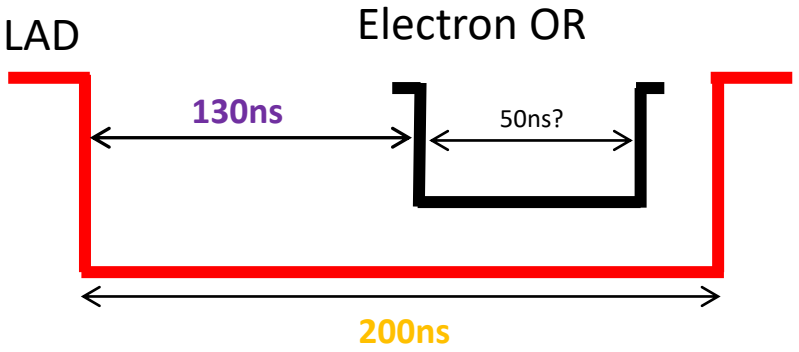
Single Arm & LAD coin

Disc

Delay?

In CH

Coincidence Timing at logic unit (including ToF and bar coincidence time variation)



Need to finalize other numbers and cable delays

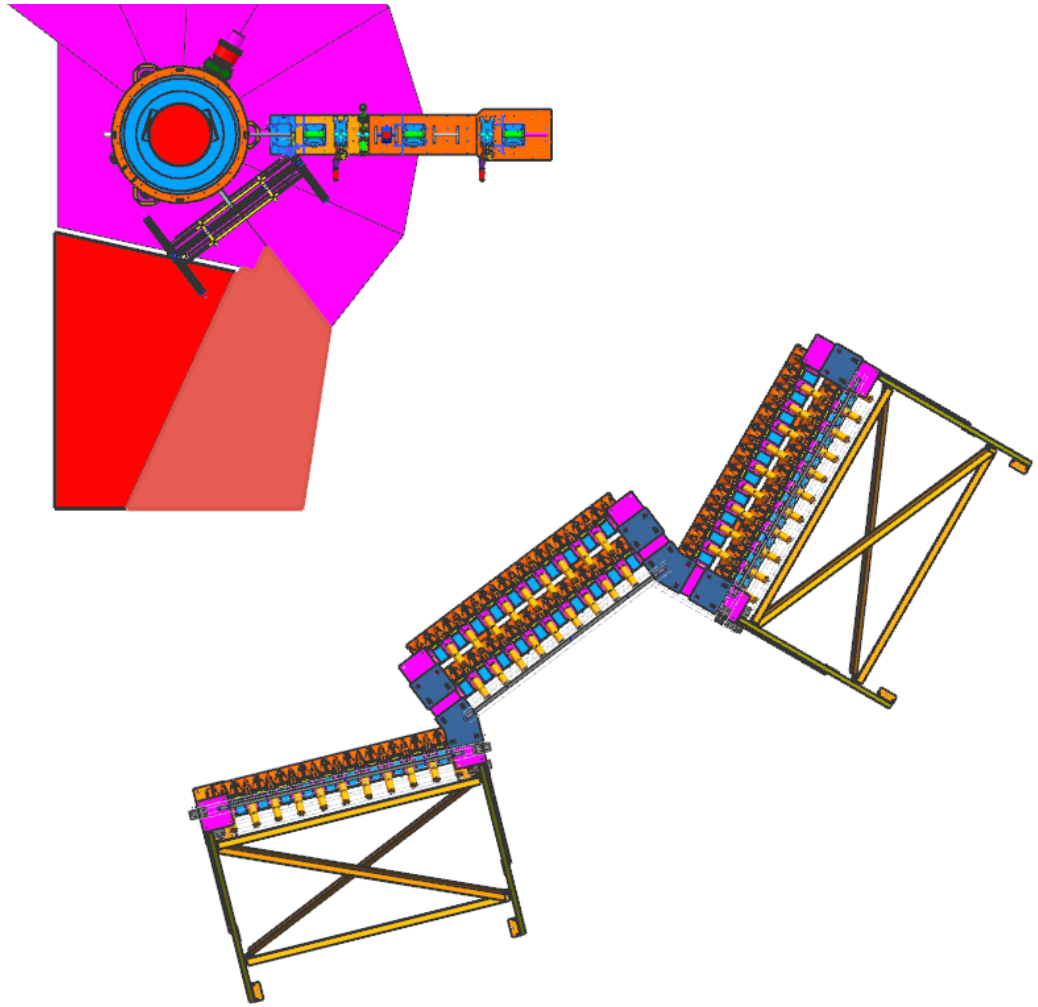
LAD Trigger Logic

- Each bar AND of Top and Bottom
- OR of all bars for main coincidence (I dont think it needs to be more complicated)
- For laser trigger require at least 5 (or more) coincidences of top and bottom
- Todo: Finish diagrams and sent logic schema to Ben for implementation

Trigger

- Main trigger: OR from both electron single arm triggers
- Supplemental trigger
  - LAD single arm for commissioning, detector checkout
  - Coincidence OR+LAD → might be necessary for absolute timing calibration, diagnostics during experiment if signal is in TDC/Scaler (PS = -1)

- Logic signal from LAD needs to go to counting house to feed TS and coincidence
- Questions:
  - Set timings with EDTM for everything? → Answer yes!
  - Currently, coincidence is timed on electron OR. Is that reasonable? → Answer yes!
  - What are retiming concerns? How does this work with the feedback of the trigger signals into ADCs? Answer: Each crate has some reference signal so a subtraction can be made in software via settings file



LAD Labeling (to be finalized)

- Four digit numbers for each bar
  - First Number = Wall (0,1,2)
  - Second Number = Layer (0,1)
  - Third and Fouth number = Bar in layer (0-10)

- For every PMT the label is extended by U/T and D/B corresponding to top or bottom PMT

Label = W L XX U/T D/B